

CLAIMS

What is claimed is:

1. In a cochlear implant system having a sound processor and multiple electrode contacts through which stimuli are adapted to be applied to a patient's inner ear, a method of "fitting" the cochlear implant system to the patient, comprising:

generating pulse trains of electrical stimuli with selectable degrees of intensity;

delivering the pulse trains of electrical stimuli to selected groups of electrode contacts while gradually adjusting the intensity of the electrical stimuli and while monitoring the stapedial reflex of the patient;

forming a contour of intensity levels associated with all of the selected electrode groups of electrode contacts at which a reflex criteria of the stapedial reflex responsive to the delivered electrical stimuli is first observed; and

using the contour of intensity levels used by the implant system to thereafter control the intensity of the stimuli applied through the electrode contacts.

2. The method of Claim 1 further including modulating the amplitude of the pulse trains of electrical stimuli.

3. The method of Claim 1 wherein the pulse trains of electrical stimuli are derived from input signals selected from a group of input signals comprising: (a) shaped bands of noise whose overall bandwidth is adjustable; (b) modulated bands of noise whose center frequencies are adjustable; (c) complex tonal stimuli whose spectra and various amplitude components are adjustable;

(d) speech tokens whose spectra and amplitude envelopes are well described;
and (e) white noise.

4. The method of Claim 3 further comprising forming a final group of electrode contacts that includes all of the electrode contacts in the selected groups of electrode contacts, and delivering the pulse trains of electrical stimuli to the final group of electrode contacts after the pulse trains of electrical stimuli have been delivered to all other groups of electrodes that include less than all of the electrode contacts.

5. A method for fitting a cochlear implant system to a patient, the cochlear implant system having a multiplicity of electrode contacts and means for delivering electrical stimuli to a selected electrode contact or a selected group of electrode contacts, the method comprising steps for:

- (a) defining a first group of electrode contacts;
- (b) simultaneously applying electrical stimuli of a known intensity level to the defined group of electrode contacts;
- (c) adjusting the intensity of the electrical stimuli applied in step (b) until a stapedial reflex criteria of the patient is observed;
- (d) recording the intensity of the electrical stimuli that produced the stapedial reflex observed in step (c);
- (e) repeating steps (b) through (d) for other groups of electrode contacts; and
- (f) using the recorded intensities obtained in step (d) for each group of electrode contacts as parameter settings for controlling the intensity of electrical stimuli thereafter applied through the electrode contacts by the implant system.

6. The method of Claim 5 wherein the recorded intensities obtained in step (d) for each group of electrode contacts comprise a contour of intensities,

and wherein the method further includes the step for grouping all of the electrode contacts into a defined last group of electrode contacts and globally shifting the contour of intensities by applying the electrical stimuli to the last group of electrode contacts and adjusting its intensity until a desired stapedial reflex criteria is observed.

7. The method of Claim 6 wherein step (b) comprises applying amplitude modulated electrical stimuli of a known intensity level to the defined group of electrode contacts.

8. The method of Claim 7 wherein step (b) comprises applying an amplitude modulated pulse train at a known intensity level and having a rate that mimics live speech to the defined group of electrode contacts.

9. The method of Claim 8 wherein step (b) comprises applying an amplitude modulated pulse train at a known intensity level and having a rate that is at least about 2 KHz to the defined group of electrode contacts.

10. The method of Claim 5 wherein step (b) comprises applying stimuli derived from input signals selected from a group of input signals comprising: shaped bands of noise whose overall bandwidth is adjustable; modulated bands of noise whose center frequencies are adjustable; complex tonal stimuli whose spectra and various amplitude components are adjustable; speech tokens whose spectra and amplitude envelopes are well described; and white noise.

11. The method of Claim 10 wherein observing a stapedial reflex criteria in step (c) comprises visually observing a stapedial reflex.

12. The method of Claim 10 wherein observing a stapedial reflex criteria in step (c) comprises measuring a change in the impedance of the tympanic membrane.

13. The method of Claim 10 wherein observing a stapedial reflex criteria in step (c) comprises implanting a stapedial electrode, and monitoring a voltage developed on said stapedial electrode resulting from depolarization of the stapedial muscle tissue.

14. A cochlear implant system comprising:
a multiplicity of electrode contacts;
means for defining groups of electrode contacts;
means for applying electrical stimuli of a known intensity level to each of the defined groups of electrode contacts;
means for observing a stapedial reflex criteria of a patient within whom the cochlear implant system is adapted to be implanted;
means for adjusting the intensity of the electrical stimuli applied to each group of electrode contacts until a stapedial reflex criteria of the patient is observed;
means for remembering the intensity level of the electrical stimuli that produced the stapedial reflex for each group of electrode contacts; and
means for using the remembered intensities for each group of electrode contacts as parameter settings for controlling the intensity of electrical stimuli thereafter applied through the electrode contacts by the implant system.

15. The cochlear implant system of Claim 14 wherein the means for applying electrical stimuli comprises means for generating speech-like stimuli, and means for simultaneously applying the speech-like stimuli to each electrode contact in the group of electrode contacts.

16. The cochlear implant system of Claim 15 wherein the speech-like stimuli comprise electrical signals derived from input signals selected from a group of input signals comprising: shaped bands of noise whose overall bandwidth is adjustable; modulated bands of noise whose center frequencies are adjustable; complex tonal stimuli whose spectra and various amplitude components are adjustable; speech tokens whose spectra and amplitude envelopes are well described; and white noise.

17. The cochlear implant system of Claim 16 wherein the means for observing a stapedial reflex criteria comprises means for visually observing a stapedial reflex.

18. The cochlear implant system of Claim 16 wherein the means for observing a stapedial reflex criteria comprises means for measuring a change in the impedance of the tympanic membrane of the patient.

19. The cochlear implant system of Claim 16 wherein the means for observing a stapedial reflex criteria comprises a stapedial electrode adapted to be implanted on or near stapedial muscle tissue, and means for monitoring a voltage developed on said stapedial electrode resulting from depolarization of the stapedial muscle tissue.